

1 20. (Amended) The integrated circuit of claim [17] 16, wherein
B1 2 the aluminum-copper-titanium alloy layer comprises about 0.5
3 atomic percent copper and about 0.1 atomic percent titanium.

REMARKS

Claims 4-6, 9-11, 14-16 and 19-21 were examined. Claim 20 is amended. Claims 4-6, 9-11, 14-16 and 19-21 remain in the application.

The Patent Office objects to the Abstract of the Disclosure. The Patent Office rejects claims 20 under 35 U.S.C. §112, second paragraph. Finally, the Patent Office rejects claims 4-6, 9-11, 14-16 and 19-21 under 35 U.S.C. §103(a). Reconsideration of the rejected claims is respectfully requested in view of the above amendments and the following remarks.

A. Abstract of the Disclosure

Applicants submit herewith a substitute Abstract of the Disclosure. The substitute Abstract of the Disclosure corresponds with the scope of independent claim 4. Applicants respectfully request that the Patent Office enter the substitute Abstract of the Disclosure.

B. 35 U.S.C. §112, Second Paragraph: Rejection of Claim 20

The Patent Office rejects claim 20 under 35 U.S.C. §112, second paragraph as indefinite. Applicants amend claim 20 to address the concerns raised by the Patent Office. Applicants respectfully request that the Patent Office withdraw the rejection to claim 20 under 35 U.S.C. §112, second paragraph.

C. 35 U.S.C. §103(a): Rejection of Claims 4-6, 9-11, 14-16, 19 & 21

The Patent Office rejects claims 4-6, 9-11, 14-16, 19 and 21 under 35 U.S.C. §103(a) as obvious over U.S. Patent No. 5,635,763 issued to Inoue et al. (Inoue) in view of U.S. Patent No. 4,999,160 issued to Lowrey et al. (Lowrey). Inoue is cited for disclosing a semiconductor device comprising a multilayered interconnection structure comprising an aluminum alloy layer between nitride and titanium nitride layers. Lowrey is cited for purportedly disclosing an aluminum-copper-titanium alloy layer as an interconnection containing 0.5-3 weight percent copper and 0.05-1 weight percent titanium.

As noted in the previous Response to Office Action, Inoue describes a multilayered interconnection structure focusing on electromigration performance and stress migration performance. Inoue describes an aluminum alloy as part of that interconnection. Examples for the aluminum alloy includes Al-Cu, Al-Si, and Al-Ti.

Lowrey describes an aluminum alloy structure of Al-Cu-Si-Ti. Thus, Lowrey describes an aluminum-silicon alloy. Lowrey notes advantages of aluminum-silicon alloy as that is inexpensive, easy to etch, and a relatively good conductor. Column 1, lines 16-18. Lowrey does not describe an aluminum-copper-titanium alloy.

Applicants' application evaluated various aluminum alloys. See pages 11-12 and Figure 7. As illustrated in Figure 7, the most striking result regarding the electromigration lifetime was seen in the aluminum-copper-titanium (Al-Cu-Ti) alloy. As illustrated by Table 1 (page 11) and Figure 7, the electromigration lifetime of the Al-Cu-Ti alloy was multiplicative rather than additive. As one of skill in the art might expect given the known properties of Al-Ti and Al-Cu alloys.

Independent claim 4 is prima facie not obvious over the cited references, because the cited references do not describe an Al-Cu-Ti alloy containing about 0.1 atomic percent Ti. Lowrey describes an Al-Cu-Si-Ti alloy. Lowrey does not describe an Al-Cu-Ti alloy. Based on the differing properties of various alloys such as illustrated in the Application at pages 11-13 and Figure 7, one cannot assume that all aluminum alloys behave similarly and thus that it would have been obvious to remove the silicon from the alloy of Lowrey. To the contrary, Lowrey teaches Al-Si alloy.

Lowrey offers no substitute for silicon or examples where silicon is not included.

For the above stated reasons, independent claim 4 is not obvious over the cited references. Claims 5 and 6 depend from claim 4 and therefore contain all the limitations of that claim. For the reasons stated with respect to claim 4, claims 5 and 6 are not obvious over the cited references.

Independent claim 9 is similar to independent claim 4 in that it describes an interconnection of Al-Cu-Ti alloy with about 0.1 atomic percent Ti. Accordingly, for the reasons stated with respect to independent claim 4, independent claim 9 is not obvious over the cited references. Claims 10 and 11 depend from claim 9 and therefore contain all the limitations of that claim. For the reasons stated with respect to claim 9, claims 10 and 11 are not obvious over the cited references.

Independent claim 14 relates to an integrated circuit comprising a substrate and an interconnection level. The interconnection level comprises an Al-Cu-Ti alloy layer containing 0.1 atomic percent Ti. In this regard, the arguments presented above with respect to independent claims 4-6 may be used to distinguish independent claims 14 and 15 from the cited references.

Independent claim 16 relates to a multi-layered interconnection structure formed on a substrate. A portion of that interconnection layer comprises an Al-Cu-Ti alloy layer containing about 0.1 atomic percent Ti. Thus, the arguments distinguishing claims 4-6 may be used to distinguish claims 16 and 19-21.

For the reasons stated above, Applicants respectfully request the Examiner withdraw the rejection to remaining claims 4-6, 9-11, 14-16 and 21 under 35 U.S.C. §103(a).

CONCLUSION

In view of the foregoing, it is believed that all claims now pending patentably define the subject invention over the prior art of record and are in condition for allowance and such action is earnestly solicited at the earliest possible date.

Respectfully submitted,

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